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(54) I.c. engine fuel injector outlets

(57) Two apertures 18 defined by flat inner surfaces joining semi-circular outer surfaces (Fig. 3) are formed in a metal or plastics cap 15 or a body (47, Fig. 2) located at the downstream end of a tube (34) integral with the wall having the injector outlet 6.

Fig.1

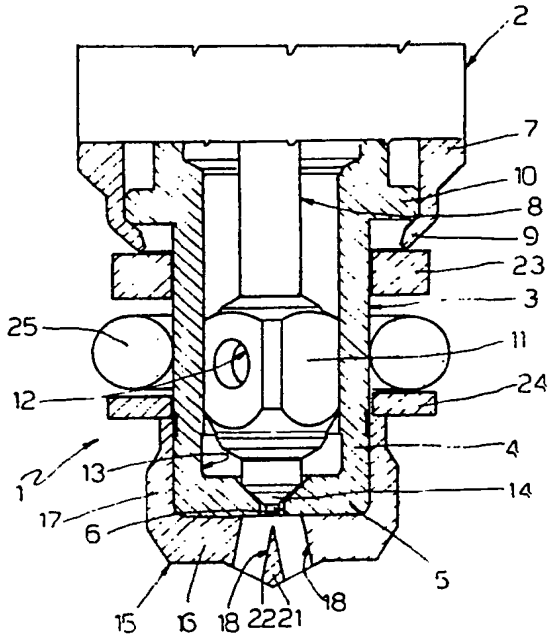

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Fig.3

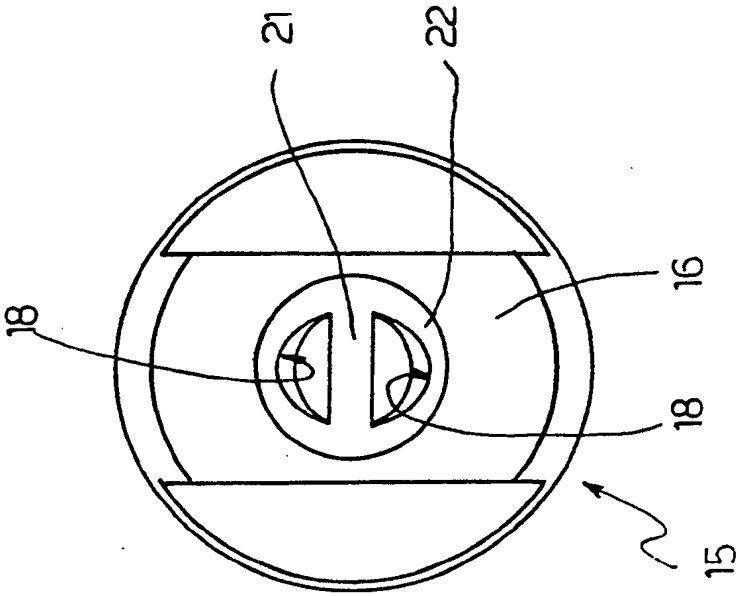


Fig.1

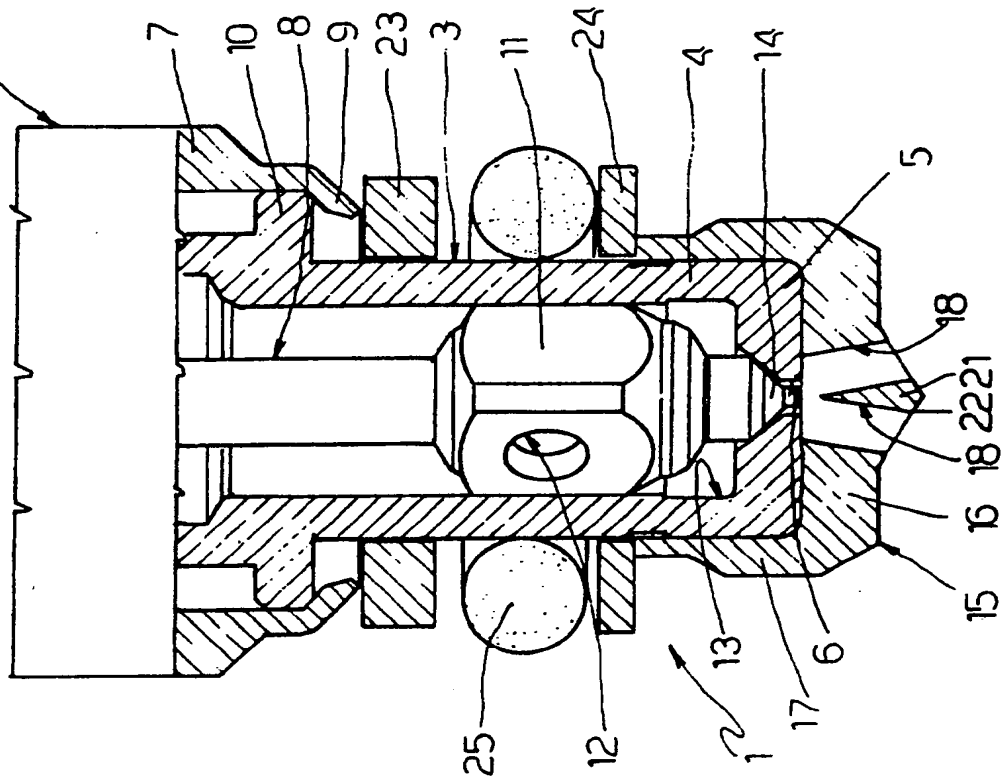
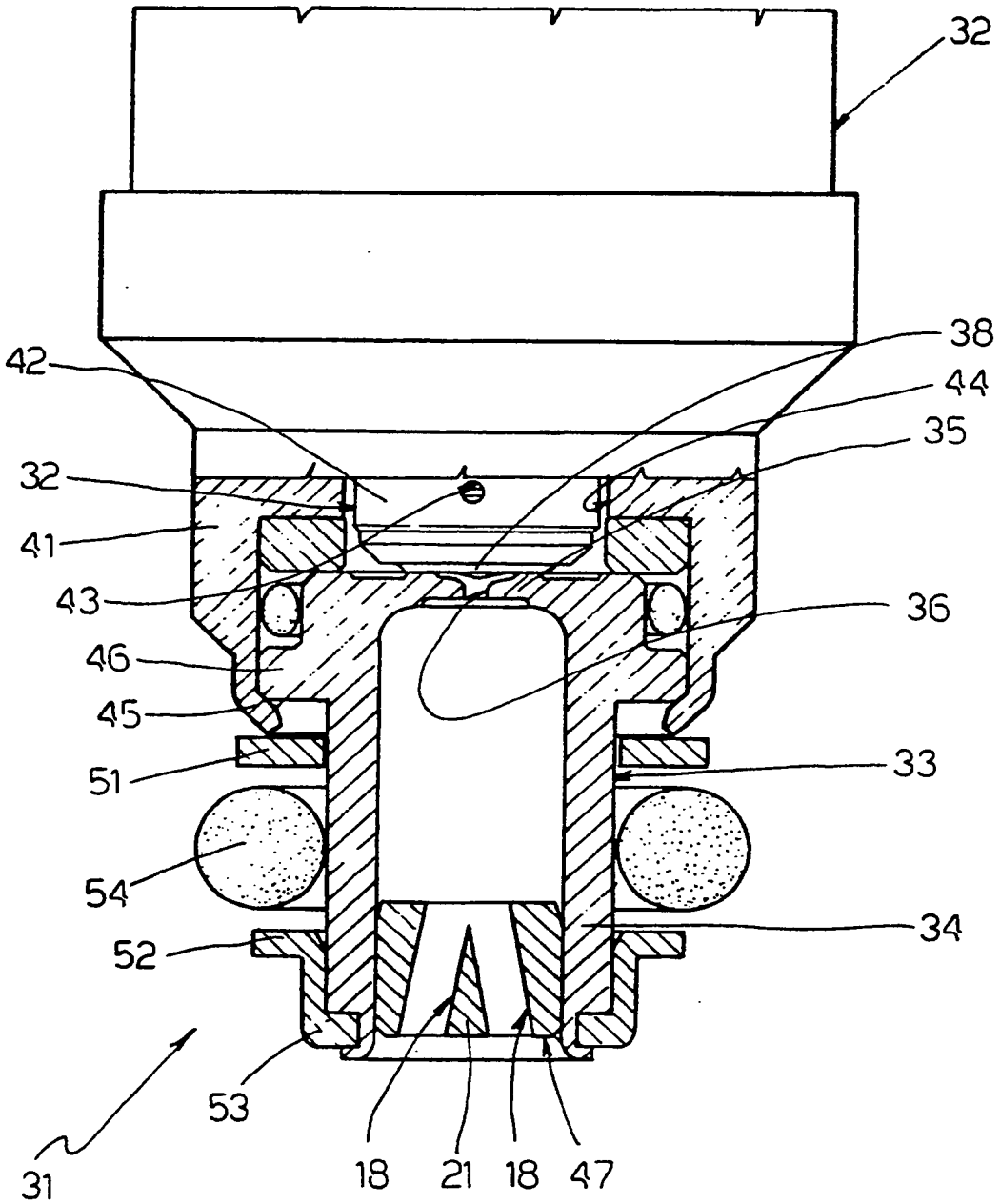


Fig. 2



A VALVE FOR AN INTERNAL COMBUSTION ENGINE FUEL INJECTION DEVICE PROVIDED WITH A DIVIDER ACTING TO DIVIDE THE FUEL JET

The present invention relates to a valve for a fuel injection device of an internal combustion engine, provided with a divider adapted to divide the fuel jet.

As is known, valves of the above indicated type include a nozzle in which a fuel injection orifice is formed for the fuel which is to be supplied to the engine. It is further known that the correct operation of the engine depends on the quality of the fuel-air mixture which in turn depends upon the degree of atomisation of the fuel which is obtained downstream of the injection orifice.

Currently the nozzle is coupled to a divider installed downstream of the injection orifice and having cylindrical apertures of reduced diameter. The two apertures are inclined and, in particular, they diverge from one another gradually as they approach the outlet openings thereof.

The valve just described has several disadvantages, above all due to the shape of the divider, which does not succeed in performing a correct division of the fuel jet. In fact, the cylindrical form of the divider

apertures separates the fuel spray, but into two compact streams. Moreover, it happens that the central region of the fuel spray bounces on the solid part of the divider defined between the inlet openings of the two cylindrical apertures. All this, as is evident, does not contribute at all to the atomisation of the fuel which is achieved downstream form the divider.

Finally it is to be noted that the rate of flow of fuel is defined by the diameter of the injection orifice so that the provision in the divider of apertures of reduced diameter, because of the dimensions of the divider itself, causes a restriction which positively limits the rate of flow of fuel, or rather does not allow the use of dividers thus formed for nozzles having a high flow rate.

The object of the present invention is that of providing a valve which will be free from the cited disadvantages and which, that is to say, will be provided with a divider which widely separates the fuel jet without limiting its rate of flow.

According to the present invention there is provided a valve for metering and atomisation of the fuel in an internal combustion engine fuel injection device, of the type comprising a nozzle in which an injection orifice

is formed, characterised in that downstream from the said injection orifice there is installed a divider acting to divide the fuel jet and for this purpose having two apertures separated by a dividing septum having two substantially flat opposite faces which delimit respective inner sections of the said apertures and the longitudinal axis of which is coaxial with that of the said divider.

For a better understanding of the present invention two preferred embodiments are now described purely by way of non-limitative example, with reference to the attached drawings, in which:

Figures 1 and 2 are sections of two different embodiments of a valve according to the principles of the present invention; and

Figure 3 is a view from below of a component of the valve of Figure 1.

With reference to Figure 1 the reference numeral 1 indicates a valve for metering and atomisation of the fuel in an internal combustion engine fuel injection system 2 (partly illustrated since it is of known type). The valve 1 includes a substantially tubular nozzle 3 and has a cylindrical side wall 4 and a lower wall 5 in which is formed an injection orifice 6. The device 2 includes a body 7 which at the bottom supports the

nozzle 3 and which has an axial bore along which a shutter member 8 is able to slide axially. A lower edge 9 of the body 7 is in use folded towards the inside to form a shoulder for an annular flange 10 extending from the side wall 4 of the nozzle 3.

It is known that preferably the fuel should flow through an axial passage formed in the shutter member into its faceted portion 11, from which through the radial holes 12 it flows into the interior of a chamber 13 defined within the nozzle 3. It is likewise known that the shutter member 8 is translated upwardly, against the action of spring means, by the attraction which a ferromagnetic armature exerts when it is excited by a suitable electric coil on a core fixed to the shutter member 8. This shutter member 8 has a substantially tapered lower end 14 which in use acts on the interior of the injection orifice 6 to close this partly or totally.

With reference to Figure 1, according to the present invention the valve 1 is provided with a divider 15 constituted by a cup-shaped cylindrical body having a lower wall 16 and a cylindrical side wall 17. The divider 15 is in use fitted onto the nozzle 3 and in particular coaxially houses the lower portion of the nozzle 3. The inner face of the wall 16 of the divider

15 is in contact with the outer face of the wall 5 of the nozzle 3. In this wall 16 of the divider 15 are formed two apertures 18 separated from one another by a substantially pyramid shape dividing septum 21.

As illustrated in Figures 1 and 3, the septum 21 has a longitudinal axis coaxial with that of the divider 15 and therefore with the nozzle 3. More precisely, the longitudinal axis of the septum 21 is coaxial with the axis of the injection hole 6. The septum 21 has a sharp upper edge which shapes the inlet openings of the holes 18. The septum 21 has a thickness gradually increasing as it goes from the inner face to the outer face of the wall 16. The two opposite faces which define the septum 21 and delimit the apertures 18 are substantially flat. The apertures 18 therefore have longitudinal axes inclined with respect to that of the divider 15. These apertures 18 have in transverse section a perimetral profile defined by an outer semi-circular section and an inner rectilinear section since it lies on the flat face of the septum 21. The width of the apertures 18 along the whole of their longitudinal axis is constant. It is to be noted that in this embodiment the sharp edge which constitutes the upper edge of the septum 21 is at a level slightly lower than that defined by the inner face of the wall 16. Consequently the inlet openings of the apertures 18 have a common region. The outlet openings

of the apertures 18 and the lower portion of the septum 21 is formed in correspondence with a projection 22 of conical form extending coaxially from the outer face of the wall 16. It is particularly significant to note that the shape of the apertures 18 allows the maximum dimensions of the divider to be exploited and, that is to say, allows apertures of greater width than the cylindrical holes formed in known dividers to be formed.

Around the nozzle 3, between an upper washer 23 fitted on the nozzle 3 and a lower washer 24 which engages on the edge of the wall 17 there is defined a seat for an annular seal 25.

With reference to Figure 2, the reference numeral 21 generally indicates a valve with the same functions and operations as the valve 1, but shaped differently. The valve 31 is installed in a device 32 similar to the device 2. The valve 31 comprises a substantially tubular nozzle 33 having a cylindrical side wall 34 and an upper wall 35 in which an injection orifice 36 is formed. The device 32 differs from the device 2 substantially by the different shape of the shutter member. In fact the device 32 comprises a shutter member 37 provided with a head 38 a flat face of which is able, in a determined operating phase, to close the injection orifice 36 from above. Also, the device 32

includes a body 41 along which the shutter member 37 is slidable in the same manner as that already described in relation to the device 2. The fuel flows along an axial bore in the shutter member 37 and at a portion 42 of this flows through the radial holes 43 and into the interior of a chamber 44 defined in correspondence with a lower portion of the body 41. A lower edge 45 of this latter is, in use, folded inwardly to support an annular flange 46 extending from the wall 34 close to the wall 35 of the nozzle 33.

According to the present invention the valve 31 is provided with a divider 47 constituted by a cylindrical body fitted to the interior of the nozzle 33 at the lower edge of the wall 34 thereof. In the divider 47 are formed two apertures similar to the apertures 18 of the device 15 and therefore indicated with the same reference numeral. The dividing septum which delimits the apertures 18 of the divider 47 is similar to the septum 21 of the divider 15 and therefore also indicated with the same reference numeral.

The divider 47 is therefore substantially constituted by the central part of the wall 16 of the divider 15. The single difference lies in the fact that in the divider 47 there is no provision of the conical projection 22.

Around the nozzle 33, between an upper washer 51 fitted on the nozzle 33 and a lower flange 52 extending from a ring 53 supported by the side wall 34 is defined a seat for a sealing ring 54.

The divider 15 or 47 can be made conveniently of metal or of a moulded plastics material. If the divider is made of metal the apertures 18 can be formed either by stamping, by electro-erosion or by laser technology.

In use, the fuel jet which exits from the injection orifice 6 or 36 is separated into two parts by the divider 15 or 47. Because of the inner shape of the apertures 18, that is to say because of the shape of the septum 21 the fuel jet is divided into two laminar jets the width of which is equal to that of the rectilinear section of the holes 18. Moreover, the pointed shape of the septum 21 eliminates bounce of the fuel jet in the central region.

From what has been explained the advantages consequent on the present invention are evident.

In particular, the valve is provided with a divider in which the apertures are shaped in such a way as to allow a more effective division of the fuel jet. Consequently the fuel is atomised more finely and this contributes to

a more effective mixture with the air and therefore to a better combustion of the mixture. Moreover the apertures 18, for the same divider dimensions, are of greater width than corresponding apertures formed in current dividers. This allows the elimination of any restriction downstream of the injection orifice and therefore enable use of the divider 15 or 47 even with valves having a high rate of flow.

Moreover, it is to be noted that the divider 15 or 47 is of simple construction and assembly and therefore of lower production cost.

Finally it is clear that the valve 1 or 31 described and illustrated here can have modifications and variations introduced thereto without by this departing from the protective ambit of the present invention.

CLAIMS

1. A valve for metering and atomisation of the fuel in a fuel injection device of an internal combustion engine, of the type comprising a nozzle in which is formed an injection orifice, characterised by the fact that downstream from the said injection orifice there is installed a divider adapted to divide the jet of fuel and having two apertures separated by a dividing septum which has two substantially flat opposite faces which delimit respective internal sections of the said apertures and the longitudinal axis of which is coaxial with that of the said divider.

2. A valve according to Claim 1, characterised by the fact that the said apertures have longitudinal axes inclined with respect to that of the said divider and by the fact that the said septum has a substantially pyramid form and thus has a thickness gradually increasing as it goes from the inlet opening of the said apertures to the outlet opening of these latter.

3. A valve according to Claim 2, characterised by the fact that the said septum has a substantially sharp edge at the inlet openings of the said apertures.

4. A valve according to Claim 3, characterised by the fact that the said apertures have a substantially constant width along their longitudinal axis.

5. A valve according to Claim 4, characterised by the fact that in transverse section the said apertures have a perimeteral outline defined by a respective outer substantially semi-circular section and by a respective inner rectilinear section lying on the corresponding flat face of the said septum .

6. A valve according to any preceding claim, characterised by the fact that the said nozzle has a tubular form comprising a cylindrical side wall and a lower wall in which the said injection orifice is formed; the said divider having a cup-shape cylindrical body adapted to house coaxially the lower portion of the said nozzle .

7. A valve according to Claim 6, characterised by the fact that the said divider includes a cylindrical side wall and a lower wall in which the said apertures are formed.

8. A valve according to Claim 7, characterised by the fact that the inner face of the said lower wall of the said divider is substantially in contact with the outer face of the said lower wall of the said nozzle.

9. A valve according to Claim 7 and/or Claim 8, characterised by the fact that the said outlet openings of the said apertures and the lower portion of the said septum are formed in a substantially conical projection extending coaxially from the outer face of the said lower wall of the said divider.

10. A valve according to any one of claims from 1 to 5, characterised by the fact that the said nozzle has a tubular form comprising a cylindrical side wall and an upper wall in which the said injection orifice is formed; the said divider having a cylindrical body housed coaxially within the interior of the said nozzle.

11. A valve according to any preceding claim, characterised by the fact that the said divider is made of metal; the said apertures being formed by punching, electro-erosion or laser technology.

12. A valve according to any of claims from 1 to 10,

characterised by the fact that the said divider is made of moulded plastics material.

13. A valve for the metering and atomisation of fuel in a fuel injection system of an internal combustion engine, substantially as hereinbefore described with reference to and as shown in Figures 1 and 3 or Figure 2 of the accompanying drawings.